

Digital Master Images - Sample Technical Specifications for Photograph Collections

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Introduction

Ideally, digital master images of photographs should be made at the highest specifications possible. Creating a rich digital master¹ will provide the greatest flexibility for the use and preservation of the digital image. What is acceptable and achievable quality varies depending on project needs and resources, although standardization is recommended within each institution. The table below summarizes representative choices made for digitizing photograph collections. In the absence of a widely accepted single standard, the data can provide planners with a starting point when developing their own specifications.

Many institutions use one specification for all sizes of photographs. This table shows how the resulting resolution differs according to the size of the photograph. Portions of the data in the table were derived using the mathematical formulas noted below. These resolution numbers are not necessarily obtainable from scanning equipment in the exact numbers noted. For example, you may not be able to set a scanner at 430 dpi to scan a 5x7 negative, but you may be able to specify approximately 3000 pixels on the long side of the image, which will provide the same resolution.

The table is arranged by type of photograph: 35mm, 4x5, 5x7, and 8x10. Within each type, the specifications for spatial resolution, tonal resolution, and file format are listed from the lowest to the highest level of quality. The specifications come from nine institutions: Arkansas History Commission, Columbia University Digital Library, Cornell University Library, Lafayette Historical Society, Library of Congress, National Archives and Records Administration, Northeast Document Conservation Center, University Library University of Illinois at Urbana-Champaign, and Western States Digital Standards Group.

Technical Specification Formulas

1) dpi and pixel dimensions a) $\text{dpi} = \text{pixel (Height or Width)} \div \text{original object (Height or Width)}$ b) $\text{pixel (Height or Width)} = \text{original object (Height or Width)} \times \text{dpi}$ 2) File size for 8-bit grayscale or 24 bit RGB: a) 8-bit grayscale: $(\text{pixel Height} \times \text{Pixel Width}) \div 1,000 = \text{Kb file size}$ b) 24-bit RGB: $([\text{pixel Height} \times \text{Pixel Width}] \times 3) \div 1,000 = \text{Kb file size}$ (Reminder: RGB is 8-bits for each of three channels – Red, Green & Blue)	1 Kilobyte (Kb) = approximately 1,000 bytes 1 Megabyte (MB) = approximately 1,000 Kb <i>Example:</i> 20,000 Kb = approximately 20 MB For tools to calculate file size estimates, see the TASI (Technical Advisory Service for Images, UK) toolbox for a “File Size Calculator” (Excel spreadsheet), or its JavaScript counterpart “Storage Requirements Estimator”. For more information on calculating the file size of digital images see <i>Moving Theory into Practice Digital Imaging Tutorial</i> : http://www.library.cornell.edu/preservation/tutorial/intro/intro-06.html
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Min = minimum specification
 Rec = recommended specification

Type of original	Spatial Resolution: Dpi	Spatial Resolution: Pixel h x w	Tonal Resolution / color: bit depth	File Size (& color)	File Format	Source	Date (of last revision)
35mm							
Negative or transparency							
	600 dpi	900x600	8 bit Gray or 24 bit RGB	540 KB Gray or 1.6 MB RGB	Uncompressed TIFF	University Library University of Illinois at Urbana-Champaign ²	December 2001
	a) 2000 dpi b) 2000 dpi c) 2000 dpi d) 2000 dpi e) 2000 dpi f) 2000 dpi	a) 3000x2000 b) 3000x2000 c) 3000x2000 d) 3000x2000 e) 3000x2000 f) 3000x2000	a) 8 bit Gray b) 12 bit Gray c) 16 bit Gray d) 24 bit RGB e) 36 bit RGB f) 48 bit RGB	a) 6 MB Gray b) 9 MB Gray c) 12 MB Gray d) 18 MB RGB e) 27 MB RGB f) 36 MB RGB	----	NEDCC Handbook for Digital Projects ³	2000
	2000 dpi	3000x2000	8 bit Gray or 24 bit RGB	6 MB Gray 18 MB RGB	TIFF 6.0 - Uncompressed - Intel (IBM)	National Archives and Records Administration ⁴	January 1998
	2048 dpi	2048x3072	8 bit Gray or 24 bit RGB	6 MB Gray 18 MB RGB	TIFF ---- or PHOTO CD	Columbia University Digital Library ⁵	1997
	2600 dpi	4000x2600	8 bit Gray	10.5 MB Gray	TIFF 6.0 Uncompressed	Arkansas History Commission ⁶	February 2000
	2600 dpi	4000x2600	8-bit Grayscale 24-bit RGB	10.5 MB Gray 31.5 MG RGB	TIFF 6.0 Intel Uncompressed	Library of Congress ⁷	2000
a) transparencies (min) b) transparencies (rec)	a) 2000 dpi b) 3300 dpi	a) 3000x2000 b) 5000x3300	8 bit Gray or 24 bit RGB	a) 6 MB Gray 18 MB RGB b) 16.5 MB Gray 49.5 MB RGB	Uncompressed a) TIFF 4,5 & 6 b) TIFF 5 & 6	Cornell University Library ⁸	March 2001
	a) 2000 dpi to b) 3300 dpi	a) 3000x2000 to b) 5000x3300	a) 8 bit Gray to b) 8 bit Gray or 24-bit RGB	a) 6 MB Gray 18 MB RGB to b) 16.5 MB Gray 49.5 MB RGB	TIFF Uncompressed	Western States Digital Standards Group ⁹	January 2003

Type of original	Spatial Resolution: Dpi	Spatial Resolution: Pixel h x w	Tonal Resolution / color: bit depth	File Size (& color)	File Format	Source	Date (of last revision)
4x5 Print, Negative or Transparency							
	200 dpi	1000x800	8 bit Gray	800 KB	TIFF ----	Lafayette, CO Historical Photo Project Handbook ¹⁰	November 2000
a) prints (min) b) prints (rec) c) transparencies (min) d) transparencies (rec)	a) 300 dpi b) 400 dpi c) 600 dpi d) 1000 dpi	a) 1200x1500 b) 1600x2000 c) 3000x2400 d) 5000x4000	8 bit Gray or 24 bit RGB	a) 1.8 MB Gray 5.4 MB RGB b) 3.2 MB Gray 9.6 MB RGB c) 6 MB Gray 18 MB RGB d) 20 MB Gray 60 MB RGB	a) TIFF 4,5 & 6 b) TIFF 5 or 6 Uncompressed c) TIFF 4,5 & 6 d) TIFF 5 & 6	Cornell University Library	March 2001
	600 dpi	2400x3000	8 bit Gray or 24 bit RGB	6 MB Gray 18 MB RGB	Uncompressed TIFF	University Library University of Illinois at Urbana-Champaign	December 2001
	600 dpi	3000x2400	8 bit Gray or 24 bit RGB	6 MB Gray 18 MB RGB	TIFF 6.0 - Uncompressed – Intel (IBM)	National Archives and Records Administration	January 1998
	a) 600 dpi b) 600 dpi c) 600 dpi d) 600 dpi e) 600 dpi f) 600 dpi	a) 8000x10000 b) 8000x10000 c) 8000x10000 d) 8000x10000 e) 8000x10000 f) 8000x10000	a) 8 bit Gray b) 12 bit Gray c) 16 bit Gray d) 24 bit RGB e) 36 bit RGB f) 48 bit RGB	a) 80 MB Gray b) 120 MB Gray c) 160 MB Gray d) 240 MB RGB e) 360 MB RGB f) 480 MB RGB	N/A	NEDCC Handbook for Digital Projects	2000
	800 dpi	4000x3200	8 bit Gray	12.8 MB Gray	TIFF 6. Uncompressed	Arkansas History Commission	February 2000
	a) 600 dpi to b) 1000 dpi	a) 2400x3000 to b) 4000x5000	a) 8 bit Gray to b) 8 bit Gray or 24-bit RGB	a) 7 MB Gray 21 MB RGB to b) 20 MB Gray 60 MB RGB	TIFF Uncompressed	Western States Digital Standards Group	January 2003

Type of original	Spatial Resolution: Dpi	Spatial Resolution: Pixel h x w	Tonal Resolution / color: bit depth	File Size (& color)	File Format	Source	Date (of last revision)
4x5 Print, Negative or Transparency (cont'd)							
	1228 dpi	6144x4900	8 bit Gray or 24 bit RGB	30 MB Gray 90 MB RGB	TIFF ---- or PHOTO CD	Columbia University Digital Library	1997
	a) 1000 dpi b) 2000 dpi	a) 4000x5000 b) 8000x10000	a) 8 bit Gray b) 16 bit Gray or 24-bit RGB	a) 20 MB Gray 60 MB RGB b) 60 MB Gray 240 MB RGB	TIFF 6.0 Intel Uncompressed	Library of Congress	a) 1997 b) 2000
Type of original	Spatial Resolution: Dpi	Spatial Resolution: Pixel h x w	Tonal Resolution / color: bit depth	File Size (& color)	File Format	Source	Date (of last revision)
5x7 Print, negative or transparency							
	150 dpi	1000x700	8 bit Gray	700 KB	TIFF ----	Lafayette, CO Historical Photo Project Handbook	November 2000
a) prints (min) b) prints (rec) c) transparencies (min) d) transparencies (rec)	a) 300 dpi b) 400 dpi c) 430 dpi d) 715 dpi	a) 1500x2100 b) 2000x2800 c) 3000x2150 d) 5000x3575	8 bit Gray or 24 bit RGB	a) 3 MB Gray 9 MB RGB b) 5.6 MB Gray 16.8 MB RGB c) 6.5 MB Gray 19.5 MB RGB d) 18 MB Gray 71 MB RGB	a) TIFF 4,5 & 6 b) TIFF 5 or 6 Uncompressed c) TIFF 4,5 & 6 d) TIFF 5 & 6	Cornell University Library	March 2001
	430 dpi	2150x3000	8 bit Gray or 24 bit RGB	6.5 MB Gray 19.5 MB RGB	TIFF 6.0 - Uncompressed - Intel (IBM)	National Archives and Records Administration	January 1998
	570 dpi	4000x2850	8 bit Gray	11.4 MB Gray	TIFF 6. Uncompressed	Arkansas History Commission	February 2000

Type of original	Spatial Resolution: Dpi	Spatial Resolution: Pixel h x w	Tonal Resolution / color: bit depth	File Size (& color)	File Format	Source	Date (of last revision)
5x7							
Print, negative or transparency (cont'd)							
	600 dpi	3000x4200	8 bit Gray or 24 bit RGB	13 MB Gray or 39 MB RGB	Uncompressed TIFF	University Library University of Illinois at Urbana-Champaign	December 2001
	a) 430 dpi to b) 715 dpi	a) 2150x3000 to b) 3575x5000	a) 8 bit Gray to b) 8 bit Gray or 24-bit RGB	a) 6.5 MB Gray 19.5 MB RGB to b) 18 MB Gray 71 MB RGB	TIFF Uncompressed	Western States Digital Standards Group	January 2003
	877 dpi	6144x4388	8 bit Gray or 24 bit RGB	27 MB Gray 81 MB RGB	TIFF ---- or PHOTO CD	Columbia University Digital Library	1997
	a) 800 dpi b) 1400 dpi	a) 4000x5600 b) 7100x10000	a) 8 bit Gray b) 16 bit Gray or 24-bit RGB	a) 18 MB Gray 71 MB RGB b) 54 MB Gray 213 MB RGB	TIFF 6.0 Intel Uncompressed	Library of Congress	a) 2003 b) 2000
8x10							
Print, negative or transparency							
	200 dpi	1000x800	8 bit Gray	800 KB	TIFF ----	Lafayette, CO Historical Photo Project Handbook	November 2000
a) prints (min) b) prints (rec) c) transparencies (min) d) transparencies (rec)	a) 300 dpi b) 400 dpi c) 600 dpi d) 1000 dpi	a) 1200x1500 b) 1600x2000 c) 3000x2400 d) 5000x4000	8 bit Gray or 24 bit RGB	a) 1.8 MB Gray 5.4 MB RGB b) 3.2 MB Gray 9.6 MB RGB c) 6 MB Gray 18 MB RGB d) 20 MB Gray 60 MB RGB	a) TIFF 4,5 & 6 b) TIFF 5 or 6 Uncompressed c) TIFF 4,5 & 6 d) TIFF 5 & 6	Cornell University Library	March 2001
	400 dpi	4000x3200	8 bit Gray	12.8 MB Gray	TIFF 6.0 Uncompressed	Arkansas History Commission	February 2000

Type of original	Spatial Resolution: Dpi	Spatial Resolution: Pixel h x w	Tonal Resolution / color: bit depth	File Size (& color)	File Format	Source	Date (of last revision)
8x10 Print, negative or transparency (cont'd)							
	a) 300 dpi to b) 500 dpi	a) 2400x3000 to b) 4000x5000	a) 8 bit Gray to b) 8 bit Gray or 24-bit RGB	a) 7 MB Gray to 19.5 MB RGB b) 20 MB Gray 60 MB RGB	TIFF Uncompressed	Western States Digital Standards Group	January 2003
	600 dpi	2400x3000	8 bit Gray or 24 bit RGB	6 MB Gray 18 MB RGB	Uncompressed 54 TIFF	University Library University of Illinois at Urbana-Champaign	December 2001
	600 dpi	3000x2400	8 bit Gray or 24 bit RGB	6 MB Gray 18 MB RGB	TIFF 6.0 - Uncompressed - Intel (IBM)	National Archives and Records Administration	January 1998
	614 dpi	6144x4900	8 bit Gray or 24 bit RGB	30 MB Gray 90 MB RGB	TIFF ---- or PHOTO CD	Columbia University Digital Library	1997
	a) 500 dpi b) 1000 dpi	a) 4000x5000 b) 8000x10000	a) 8 bit Gray b) 16 bit Gray or 24-bit RGB	a) 20 MB Gray 60 MB RGB b) 60 MB Gray 240 MB RGB	TIFF 6.0 Intel Uncompressed	Library of Congress	a) 1997 b) 2000
	a) 2000 dpi b) 2000 dpi c) 2000 dpi d) 2000 dpi e) 2000 dpi f) 2000 dpi	a) 16000x20000 b) 16000x20000 c) 16000x20000 d) 16000x20000 e) 16000x20000 f) 16000x20000	a) 8 bit Gray b) 12 bit Gray c) 16 bit Gray d) 24 bit RGB e) 36 bit RGB f) 48 bit RGB	a) 320 MB Gray b) 480 MB Gray c) 640 MB Gray d) 960 MB RGB e) 1.44 GB RGB f) 1.92 GB RGB	N/A	NEDCC Handbook for Digital Projects	2000

¹ The phrase “rich digital master” refers to a digital image of sufficiently high quality to capture the essential physical and subjective visual elements of an original photograph. Such digital masters may be used for high resolution electronic or print reproduction and for creation of derivative files that aid reference and access. Rich digital masters also facilitate preservation of the digital images as electronic surrogates of the original photographs.

² Pixel dimensions and file size derived from data provided in the document.

Digital Imaging and Media Technology Initiative, University Library University of Illinois at Urbana-Champaign: *Draft Version #3: Guidelines for Digital Imaging Projects*, (Champaign, IL: University Library, University of Illinois at Urbana-Champaign, December 2001), <http://images.library.uiuc.edu/resources/digitalguidev3.pdf>

³ Dpi, portions of the pixel dimension derived from data provided in document.

Steven Puglia "Technical Primer." in *Handbook for Digital Projects: A Management Tool for Preservation and Access*, ed. Maxine K. Sitts, 83-102 (Andover, MA: Northeast Document Conservation Center, 2000), 88. Also available online at <http://www.nedcc.org/digital/dman.pdf>.

⁴ Dpi, portions of the pixel dimensions and file size derived from data provided in the document.

National Archives and Records Administration: *NARA Guidelines for Digitizing Archival Materials for Electronic Access*, Steve Puglia and Barry Roginski, January 1998, http://www.archives.gov/research_room/arc/arc_info/guidelines_for_digitizing_archival_materials.html

⁵ Dpi, portions of pixel dimension, and file size derived from data provided in document.

Columbia University Digital Library: *Technical Recommendations for Digital Imaging Projects*, Image Quality Working Group of ArchivesCom, a joint Libraries/AcIS committee, April 1997 <http://www.columbia.edu/acis/dl/imagespec.html>.

⁶ Dpi, portions of the pixel dimension and file size derived from data provided in document.

Arkansas History Commission, Stage One Digitization Project, *State of Arkansas Department of Finance and Administration Request for Proposals RFP-00-0796 "Scanning of Photographic Materials,"* February 2000, <http://www.ark-ives.com/photo/images/pdf/P000796.PDF>, and *Answers to Questions Submitted on RFP-00-0796 by Scanning Vendors February 23, 2000*, <http://www.ark-ives.com/photo/images/pdf/ScanQA2.pdf>.

⁷ Dpi, portions of the pixel dimension and file size derived from data provided in document.

Library of Congress, Library of Congress RFP97-9: "Conversion of Pictorial Materials to Digital Images" <http://memory.loc.gov/ammem/prpsal9/rfp9.pdf>.

⁸ 1) prints: pixel dimensions and file size derived from data provided in the document; 2) transparencies: dpi, portions of the pixel dimensions and file size derived from data provided in the document.

Cornell University Library, *Report of the Digital Preservation Policy Working Group on Establishing a Central Depository for Preserving Digital Image Collections – Part 1: Responsibilities of Transferee* Version 1.0, March 2001, <http://www.library.cornell.edu/imls/image%20deposit%20guidelines.pdf>.

⁹ Dpi, portions of the pixel dimensions and file size derived from data provided in the document.

Western States Digital Standards Group, *Digital Imaging Best Practices Version 1.0*, Western States Digital Standards Group - Digital Imaging Working Group, January 2003 (Last modified 2003-03-05), http://www.cdphheritage.org/resource/scanning/documents/WSDIBP_v1_2003-01-13.pdf.

¹⁰ Dpi, portion of pixel dimensions and file size derived from data provided in document.

Lafayette, CO Historical Photo Project Handbook, *Lafayette Historical Photo Project Handbook*, Kathy Mitchell, November 2000, p. 22, <http://www.cdphheritage.org/heritage/documents/lafayette.pdf>.